A Blueprint for Success

Identifying and eliminating unwanted influences that cause undesirable results

To eliminate undesirable changes in weighing test results, it is important to know what physical and environmental unwanted influences are present and how to change them. These influences include the environmental and physical layout of the laboratory, electrostatic discharge (ESD), the installer and the user.

Laboratory Layout and Conditions

The environmental and physical conditions of the laboratory need to meet the following criteria in order for your balance to perform at an optimal level.

a. Only one access door. This will help prevent air drafting.

b. Limited personnel access to prevent drafting, and other changes to the environment such as temperature, relative humidity and atmospheric pressure.

c. A limited number of windows. If there are windows, they should have a northern exposure to limit direct sunlight.

d. The work surface that is dedicated to the balance should be located at a corner of the room, immediately opposite the wall containing the door. The door should swing inward into the laboratory with the balance table positioned so that the door can act as a shield against drafting from sources external to the laboratory.

The condition of the working surface should be clean, firm and stable. Make sure that it does not feature dual or tandem connection to the floor and a wall. If at all possible, it should be used only for work involving the balance.

e. Pay attention to the ergonomics of the workstation. Ensure the balance does not need to be moved to meet the various requirements induced by testing and user parameters. Balances are not designed to be moved around between applications, technicians and laboratories. If a balance is moved after installation, the results of your installation and calibration work are gone.

f. Evaluate the impact of air currents surrounding the balance. There are two simple ways to evaluate its impact. The first of these is to use a smoke tube—a simple device that when activated generates a harmless trail of smoke that will follow any ambient air currents. A good visual indication, it is sufficient only for the time that you are actually conducting the test.

A second method uses the balance itself as a "breeze sensor." To conduct this test, complete installation and set-up following the manufacturer's instructions. Then, following the manufacturer's instructions, connect the balance to a computer. Configure the balance to interval print every five seconds. Configure the computer so the information from the balance is imported into an Excel® spreadsheet. Begin the test by activating the print sequence on the balance. Allow this interval "printing" to continue for whatever period of time you feel necessary to secure an evaluation of the environment surrounding the balance. Look for air currents that could impact your results. Once the test is complete, shut off the interval testing. Chart the results of the data now resident in your spreadsheet. Evaluate the results to determine whether there are factors in the environment that will lower the risks of air currents.

Often times an optional breeze-break will modify the undesired behavior. Even if you are using an analytical-style balance (i.e., those devices with an integral breeze-break), this observation should not be overlooked.

g. Is vibration present in your work area? This contaminant can come from something as subtle as a person walking by, to the constant low-frequency hum of a large piece of manufacturing equipment located several work-areas away. If at all unsure, make a low-cost investment (usually less than $100) in anti-vibration pads that can be installed under the feet of the balance.

h. The most common technology used for a balance is electro-magnetic force restoration. Its very name implies the heart of the technology—the use of a magnetic field. It follows then that other magnetic fields within close proximity to the balance may cause weighment errors. Sources of magnetic fields can range from small motors, computer displays and the like, to a surprise culprit—test weights and mass standards.

i. Be aware of power-line noise. If possible, ensure that the balance is connected to a dedicated power circuit, or, at a minimum, use a conditioned "power-strip" to ensure against errors in repeatability.

j. Are there sources of RFI/EMI? Some of our 21st century conveniences, now considered most important to productivity, can significantly interfere with the proper operation of a weighing system. Consider two-way radios, cell phones, cordless phones, wireless LAN communications, and a multitude of other electronic devices. With the balance operating and presenting a stable zero reading, use your two-way radio, cell phone or other electronic device within close and various proximities to the balance. Any sudden change in reading may indicate some level of interference and corrective action should be considered. Another alternative is to locate a professional with experience at detecting, measuring and compensating for RFI and EMI.

k. Monitor temperature fluctuations. The

temperature swing over the course of a normal 24-hour period should be absolutely minimal (certainly not more than 1 – 2 degrees C thus keeping temperature drift to within 1 – 2ppm). Many factors prevent this ideal except in the most controlled environments. This is the reason that many of today's balances have automatic, internal temperature-sensitive calibration. The balances will constantly monitor the surrounding ambient temperature. When a change that could affect the outcome of a weighment is detected, either the operator is notified that recalibration is required, or the device's own internal calibration routine automatically compensates for the temperature change.

Another temperature factor involves fluctuations within the balance itself. Balances are not designed to be turned on and off as we would a centrifuge, oven, stirring device, etc. Once a balance has been installed leave it on. The amount of electrical energy consumed by most balances in today's marketplace is relatively miniscule. This is particularly true when compared to the significant levels of uncertainty induced when the balance is not kept at its own optimal internal thermal equilibrium. It should be noted as well that whenever using a balance with an enclosed weighing chamber, never insert your hand into the weighing chamber itself when loading or unloading the balance or placing samples inside of the chamber for temperature equalization. Your hand generates both heat and moisture that can disturb the sensitive micro-environment present within the chamber. Always use a tweezers or other mechanical gripping device to place things in or remove things from the weighing chamber. Also, when choosing a container to hold a weighing sample, select one that has a small surface area.

Your laboratory should be free from windows and direct sunlight. If such a consideration is impossible, be sure to keep your weighing area away from windows, direct sunlight and heat and refrigeration sources. This will go a long way to improving reliability and extending the service life of the device.

l. **Monitor humidity fluctuations.** The ideal humidity range for most balances is between 45% and 60% non-condensing RH. The weight of a sample will increase or decrease depending on its exposure to volatile substances. Similarly, the sample will behave differently dependent on the evaporation of water or the absorption of moisture by the sample itself. To control these contaminants, always use clean and dry weighing containers to hold the sample(s) under test. Weigh boats are a perfect solution for this problem as they are inexpensive and readily available. Keep the weighing platform and/or weighing chamber clean and free from foreign substances that may interfere with the testing results. Never weigh a commodity directly on the balance weighing surface. Always use a weigh boat.

Electrostatic Discharge (ESD)

Electrostatic discharge (ESD) is truly one of those areas of discipline that often goes unnoticed, even when a device seems to refuse to weigh correctly. ESD usually demonstrates itself in one of two ways. Either repeated weighments of the same sample return dissimilar results, or, the reading on the weight display is unusually unstable even though all other environmental concerns seem to be accounted for. In these cases, attempt to counteract ESD by doing one or more of the following:

- Avoid weighing vessels made of plastic. Glass is preferable.
- Ground the device. Ensure that the balance is grounded. This usually means more than presuming that the grounding plug that came with the device is sufficiently handling the problem. It also means running a wire from the chassis of the device to a direct ground connection.
- Ground the technician. There are many sources of various grounding methods for laboratory technicians such as wrist straps, ESD-proof laboratory coats, anti-static hand soap, and more.
- Use anti-static brushes to discharge ESD within the weighing chamber and on some samples. These devices come with a slightly radioactive, yet virtually harmless amount of polonium. The brush bristles remove physical contaminants while the polonium eliminates the static contamination.
- Discharge ESD in the balance's immediate environment. There are a number of solutions that provide a constant stream of neutralized ion air that eliminates even the remotest possibility of static build up.
- If all of these safeguards fail to correct the problem, you may have to consider using only metal sample containers for your work.

The Installer

There are basically three types of "installers" for precision weighing equipment—laboratory technicians, maintenance staff or dealer technician. If you have purchased your balance directly from one of the major catalog suppliers, your options for installation and maintenance are limited to either a laboratory technician or the in-house maintenance staff. Find the individual with the most experience and ensure they thoroughly follow the instructions that come with the device. If you have purchased your balance from a local scale or balance dealer, you have the benefit of requesting installation by a dealer technician. A scale or balance dealer's technician is a trained professional, who, by definition, is sensitive to all of the factors critical to balance operation. Additionally, you have the benefit of being able to call them back and trouble-shoot either the device or the environment if you run into difficulty.

The User

Operator training and certification on a weighing device cannot be overstated. Operator errors are not only a result of individuals being inadequately trained, they also add untold degrees of uncertainty to valuable test results. Every operator should have at least a cursory background on weighing technology, even if it is limited only to the device in question. Additionally, they should have a thorough understanding of the test process and the necessity to correctly record data thus preventing an erroneous influence in the significant process evaluation.

In summary, careful planning and/or suitable corrective action will minimize and possibly even eliminate many sources of uncertainty within your weighing process. It is possible that you will determine the need to test the balance at its planned location, and perhaps other alternative working sites in order to arrive at the best performance parameters. This will exclude influences of the surroundings or the operating personnel. By controlling the optimum performance of the balance based on its location and proper installation, you can significantly reduce uncertainties in your weighing processes. ■

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